grade of observers in the Weather Bureau. Those who pass the examination for assistants will, of course, be also eligible as observers, and their promotion to higher grades will follow in due course.

The steady progress of meteorology and the increasing scope of the work of the Weather Bureau justify a demand for the services of the best class of men. Inasmuch as the highest professorships must be filled by steady promotion from the lower ranks, and as they presuppose a wide range of knowledge in physics and mathematics, languages and meteorology, it is evident that the young men who enter the service of the Weather Bureau must show acquirements that give promise of future study and progress and, consequently, eminence.

It is not to be denied that many who would naturally have made meteorology their life work, failed to do so because in early life no stimulus by way of instruction in this line of study was available. At the present time, however, this need can easily be supplied, since many high schools are introducing physics and meteorology into their courses of instruction, and the colleges will, undoubtedly, introduce it into their curricula as soon as the funds are provided to satisfy the increasing demand.

It is, however, a grave question whether in the present condition of affairs it would not be well to have at Washington a central school for both elementary and advanced courses of instruction in physics, mathematics, climatology, meteorology, and modern languages. This would relieve observers in charge of stations of the necessity of training inexperienced men in their duties, and secure both greater uniformity and higher standards in the attainments of the Weather Bureau observers. If a four-years' course is necessary for the preliminary education of a second lieutenant in the Army and the ensigns in the Navy, still more must this be true of the men who are to do the weather forecasting, river and flood predictions, and cognate scientific problems of the highest complexity that are pressing upon us for solution. The general organization of the Weather Bureau, like that of all Government offices, looks to the accomplishment of a great amount of very useful daily work, but, in addition to this, there is a demand for the solution of difficult problems in science as a prelude to still wider and more important daily work. Such solutions are not likely to be forthcoming until we have evolved men who have the genius and the training necessary for original research. Our standard of scientific efficiency must be raised higher.

RHODE ISLAND WEATHER.

Mr. William Foster, Jr., of Warwick, R. I., writes:

In my younger days I was a pretty close watcher of weather phenomena. * * * On several occasions I suggested in the public papers that the Government should institute definite observations throughout the country for obtaining the necessary data to determine the laws of storms. Though this has now been done the end is not yet. There are influences coming in which seem to block the general trend of the ordinary conditions. Hence, forecasts sometimes fail and the Weather Bureau gets a scoring. Early this season I removed from Providence to Warwick * * * and have become satisfied that some of our conditions here are abnormal. In July, August, and September, I noticed that the smoke from the locomotives passing in front of the station presented a peculiar appearance not readily mingling with the atmosphere. I also noticed that there is a prevalent haze, but this has passed away since early in November. Has this been observed elsewhere?

ST. ELMO'S FIRE.

Mr. E. P. Alexander, from Georgetown, S. C., communicates the following interesting item:

In August, 1885, I was traveling from Shoshone Falls, Idaho, to the Union Pacific Railroad about dark of a cloudy afternoon. The country is uneven tableland of volcanic formation, moderately covered with sage brush and a raw wind of about 8 miles per hour faced us. As darkness approached, from a rear seat I saw a faint streak of light on the frayed end of a stout switch with which our driver drove his tired mules. I vaguely thought that the sun must be still above the horizon and shining horizontally through a very fine slit in the clouds, so as to catch the end of the switch 3 feet above the level of my eye, but not observable by me. But in about three minutes the driver struck the mule again, and again there was a streak of light illuminating the top of his switch as it was raised in the air. I borrowed his switch and raised it over my head and about 3 feet above, the end of it glowed with something like St. Elmo's fire. It was sharply extinguished when held just below that level, and as sharply ignited when raised into or above it. The phenomenon was repeated as often as we tested for it until we reached our destination, the nearest station to Shoshone Falls. My idea at the time was that the friction of the breeze on the resinous foliage of the sage brush had in some way caused the existence of an electrified current about 8 feet above the earth, such as that which causes the St. Elmo's lights at sea.

BALL LIGHTNING.

The following letter from Mr. Edward M. Boggs, civil and hydraulic engineer, at Los Angeles, Cal., seems to corroborate the suggestion of the Editor on page 358 of the August REVIEW. If our explanation is correct, then similar phenomena should be frequently observable by the employees on our railroad trains. Will not some one inquire of them?

Referring to the supposed "ball" lightning described by Mr. C. N. Crotsenburg on page 358 of the August REVIEW, I beg to offer the following as a plausible explanation of the phenomenon:

The appearance and the movements of the luminous body were such as might be caused by the reflection of some strong light, carried on the train, from a close succession of raindrops depending from a telegraph wire. Perhaps the strong red glare from the locomotive fire box was the origin of the light. The undulations of the telegraph line would change the height of the object, cause its observed oscillating motion, and would account for the seeming change in horizontal distance and the occasional disappearances, while the varying angle of reflection, due to curves in the road, would cause the light to gain or lose in distance alongside the train.

Mr. T. P. Yates, voluntary observer at Waverly, N. Y., writes, under date of November 12, as follows:

I was much interested in your "ball lightning" article in the August REVIEW, but disappointed at there being no more data. I now give you a narrative related to me by Morris Barton some years ago, who saw it at the time he lived near Danby [Danbury?], in Connecticut:

"I was standing in a barn boor, facing a farmhouse, during a passing thunder shower, in the daytime, when my attention was taken by a ball of lightning moving toward the house. It entered the room through an open door, and passed out of an opening on the other side into the open air and out of my sight, and directly after there was a loud explosion as the ball encountered an apple tree beyond, which shattered the ball to pieces."

Further questioning only elicited the facts that "a woman who was doing some housework in the room was greatly frightened;" that he "drew a breath of relief when it passed out on the other side;" that "it was as big as a pumpkin and of a deeper color;" and that "it floated and bobbed leisurely along until it hit the tree." I have no doubt he gave a correct account as it appeared to him. This is the most authentic account by an eye witness that I have come across. Nothing of the kind has yet come before my vision.

The exact date of the above occurrence can not now be stated, but it was over twenty-five years ago. Possibly some one now living in Danbury, Conn., may be able to send it to the Editor.

CLOUD PHENOMENA AT SUNRISE AND SUNSET.

Mr. S. L. Brooks, voluntary observer, The Dalles, Oreg., forwards two beautiful photographs showing streaks of light illuminating the under surface of a layer of alto-stratus cloud just before sunrise of December 2. The illuminated cloud resembles the tail of a comet reaching from the horizon far up to the northeast over an arc of nearly 90°. After 8:15

a. m. the sun shone through this cloud, dissipating it temporarily. On December 3, a similar light was observed at about the same hour, but the cloud was denser and was not subsequently dissipated.

Mr. Brooks's photograph is the first that we have seen illustrating the delicate illumination of the under surface of a cloud at sunrise or sunset. But such phenomena are very common and always excite admiration during sunsets in the eastern portion of the United States. They are especially brilliant when the sky is clear in the distant west so that as the sun disappears below the horizon in a dry, clear air his beams, for a few minutes strike upward on the under surface of a broad layer of clouds. Under these conditions, the observer sometimes sees long streaks of gorgeous colors, at other times symmetrical arrangements of bright spots, both of which show that the under surface of the cloud is not a smooth and uniform surface, but is sometimes thrown into waves, the lowest limits of which are illumined by the sun; at other times it is thrown into irregular dimples and is full of masses of denser cloud distributed among the lighter and rarer material.

From an artistic point of view photographs of these sunset illuminations have much interest, but from a meteorological point of view still more. One of the oldest methods of determining the height of the clouds consists in measuring the angular altitude and azimuth of a cloudy point that is just on the border between the dark section of the sky and the illumined portion. By noting the time exactly, one is able to compute the apparent position of the upper limb of the sun, and by assuming that the light from the upper limb is that which, grazing past the edge of the spherical earth, last falls upon the cloud, one can easily calculate the point at which this line intersects the line of sight of the observer and, therefore, the point at which the clouds must exist. Special tables to assist in this calculation were published by Zenker in his Meteorological Calendar for 1887. The method in general was proposed by James Bernoulli in 1744, and was extensively applied by Liais in 1854, but in its application one must be very sure that the beam of light from the sun grazes the surface of the ocean or the lower level planes of the earth's surface and not the tops of clouds or mountains.

If such beautiful photographs as those of Mr. Brooks could be accompanied by two necessary items, namely, the exact second of the correct time and a scale of angular altitude and azimuth, then Bernoulli's method could be applied to a large surface of alto-stratus cloud and would give us much information with regard to its altitude and its irregularities.

DISTANT THUNDER.

The Rev. J. J. Abell, of the Bethlehem Academy, St. John, Ky., makes the following interesting observation:

On the evening of January 12, 1899, at 7:07, central time, the writer observed lightning to the northwest. He began counting seconds, but ceased counting after a minute and a half had elapsed without audible thunder. Low and heavy thunder began rolling in the northwest upward of a minute later. This was so remarkable that with watch in hand he awaited a repetition of the lightning.

At 7h. 11m. 05s. he observed a flash that illumined a band along the northwest horizon about 50° long and 10° wide. At 7h. 13m. 45s. came the heavy, low, but unmistakable roll of thunder, again from the northwest.

The air was perfectly calm, and its temperature 49° F. The geographical position of the observer was latitude, 37° 42′ north; longitude, 86° 00′ west (Greenwich).

Mr. Abell remarks that the above interval of 160 seconds, with an air temperature of 49°, corresponds to a distance of 33.6 miles. This observation is interesting in connection with the statement made in many text-books that an interval of longer than eighty seconds is rarely or never observed.

A NEW STYLE OF ANEROID.

According to a circular received from Mr. Edward Whymper, a modified form of aneroid has been invented by Col. H. Watkins, of the British Army, which has given better results in the hands of surveyors and mountaineers than any other thus far tried by Mr. Whymper. The instruments of this kind are now made by Mr. J. J. Hicks and will be known as Watkins' Mountain Aneroids.

Mr. Whymper states that all aneroids, when carried to higher points in the atmosphere, lose with respect to the mercurial barometer, that is to say, read lower than it. When tested under the receiver of an air pump, when the pressure is diminished rapidly, the aneroid will, in a short time, read lower than the mercurial even though they may agree exactly at the first minute. The greater the length of time that the aneroid is kept under low pressure so much the greater is the loss. It appears, moreover, that when returning to the normal pressure at sea level the aneroid will, in the course of time, recover all its previous loss and read correctly.

Manufacturers and inventors have endeavored to diminish these errors. The former have attempted to abolish the fundamental cause, and the latter to shorten the length of time that the corrugated disks are exposed to the influence of the low pressure.

The Watkins aneroid is so constructed that the corrugated disk is put in action when required and thrown out of action when it is not wanted for use. In order to accomplish this the lower portion of the vacuum box, instead of being a fixture, is free to rise, thus relieving it of any strain. When a reading is required, a fly-nut is screwed up as far as it will go, thus bringing the instrument into the normal condition in which it was graduated.

Actual comparison between aneroids and mercurials throughout Switzerland in 1898 seems to show that the new form of aneroids is about as good as the mercurial barometer itself. It is very unfortunate that the new instrument does not easily lend itself to continuous registration as in the case of the ordinary aneroid.

LOW PRESSURES AND TIDAL WAVES.

Mr. H. C. Russell of Sidney, New South Wales, is said to have proved that of the so-called tidal waves observed near that place only 1 per cent is produced by seismic disturbances, while 60 per cent is due to low pressures producing waves in the South Pacific.

A tidal wave, as we have said in the MONTHLY WEATHER REVIEW for 1896, must not be confounded with a wind wave or waves produced by earthquakes. The use of the term tidal is oftentimes quite improper and unwarranted. The great waves that are reported on the Australian tide gauges may be due to heavy winds, but there is no reason to think they are due to special tidal action.

FLOATING SPIDER WEBS.

A paragraph in the Advertiser of Montgomery, Ala., states that on November 21, numerous batches of a spider-web substance were seen floating in the air and falling from the trees and leaves to the ground. Some of it was in films 15 or 20 feet long, but occasionally masses a few inches in length and an inch or more broad were observed. The author of the paragraph states that it was not spider web but resembled fine fibers of asbestos, and that it was probably connected with the fall of November meteors. It is also said to have shown a phosphorescent effect.

As there are several species of spiders that float indefi-